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(54) Abstract Title
Method and apparatus of particle transfer in multi-stage particle separators

(57) An improved two-stage separator uses reusable containers for collecting particles separated by each separation stage. The reusable containers are constructed such that a user empties both reusable containers by the actions required to empty just one of the reusable containers.

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Method and apparatus of particle transfer in multi-stage particle separators

Claims of corresponding document: **WO0195780**

I CLAIM: 1. A vacuum cleaner comprising: (a) a cleaner head having a dirty air inlet; and, (b) a casing having a filtration member, the filtration member having an inlet in fluid flow communication with the dirty air inlet and an outlet in fluid flow communication with a source of suction, the filtration member comprising at least one upstream particle separator having an associated upstream particle collector and at least one downstream particle separator having an associated downstream particle collector, the particle collectors are configured such that the downstream particle collector is emptied by transferring its contents into the upstream particle collector.

2. The vacuum cleaner of claim 1 wherein at least a portion of the upstream particle separator is removable from the casing and the downstream particle collector is emptied into the upstream particle collector when the when the portion of the upstream particle collector is removed from the casing.

3. The vacuum cleaner of claim 1 further comprising a particle transfer member positioned between one of the particle separation members and its associated particle collector whereby particles separated by the said particle separation member are conveyed to said particle collector.

4. The vacuum cleaner of claim 3 wherein at least a portion of the particle transfer member is angled downwardly whereby particles travel to said particle collector at least partially under the influence of gravity.

5. The vacuum cleaner of claim 1 wherein the downstream particle separation member is chosen from the group of a cyclone, a Prandtl layer turbine and an electrostatic filter.

6. The vacuum cleaner of claim 1 wherein the downstream particle collector is positioned in the upstream particle separation member.

7. The vacuum cleaner of claim 2 wherein the downstream particle collector is pivotally mounted above the upstream particle collector.

8. The vacuum cleaner of claim 2 wherein the downstream particle collector has side walls and a bottom that is mounted for movement between a closed position and an open position and the bottom moves to the open position as the upstream particle collector is prepared for emptying.

9. The vacuum cleaner of claim 8 wherein the bottom is maintained in the closed position by interaction between the bottom and a member positioned on a portion of the vacuum cleaner that is not removed with the upstream particle collector.

10. The vacuum cleaner of claim 2 wherein the downstream particle collector is disposed adjacent the upstream particle separation member.

11. A separator for separating entrained particles from a fluid flow, the separator comprising: (a) a first particle separation member; (b) a reusable particle collector disposed beneath the particle separation member, the particle collector having a moveable member movably mounted between a closed position and an open position; and, (c) a particle receiving chamber disposed beneath the particle collector, wherein when the moveable member moves from its closed position to its open position, particles collected in the particle collector are substantially transferred to the particle receiving chamber.

12. The separator of claim 11 wherein the first particle separation member is chosen from the group of a cyclone, a Prandtl layer turbine and an electrostatic filter.

13. The separator of claim 11 further comprising a second particle separation member, wherein the particle receiving chamber receives particles separated from the fluid flow by the second particle separation member.

14. The separator of claim 13 wherein the second particle separation member has an outer container and a first assembly positioned in the outer container, the reusable particle collector has side walls and the moveable member comprises a lower portion and the side walls are removable with the first assembly from the outer container.

15. The separator of claim 13 wherein the second particle separation member has an outer container and a first assembly positioned in the outer container, the reusable particle collector has side walls mounted on the removable assembly, the moveable member comprises a lower portion and the lower portion is mounted on the outer container for rotational movement with respect to the side walls.

16. The separator of claim 13 wherein the second particle separation member has an outer container and a first assembly positioned in the outer container, the reusable particle collector has side walls and the moveable member comprises a lower portion pivotally mounted with respect to the side walls and lockable in the closed position by interaction with a member provided on the outer container.

17. A separator comprising: (a) an inlet in fluid flow communication with a source of fluid having particles therein; (b) a particle separation member; (c) a first particle collector disposed below the particle separation member; and, (d) a particle transfer member positioned between the particle separation member and the particle collector whereby particles separated by the particle separation member are conveyed to the particle collector.

18. The separator of claim 17 wherein at least a portion of the particle transfer member is angled downwardly to the first particle collector whereby particles travel to the first particle collector at least partially under the influence of gravity.

19. The separator of claim 17 wherein the first particle separation member is chosen from the group of a cyclone, a Prandtl layer turbine and an electrostatic filter.

20. The separator of claim 17 further comprising a second particle separation member disposed upstream of the first particle separation member.

21. The separator of claim 20 further comprising a second particle collector positioned to receive particles separated by the second particle separation member and the first and second particle collectors are configured such that the first particle collector is emptied when the second particle collector is emptied.

22. The separator of claim 21 wherein the first particle collector is disposed above the second particle separation member.

23. The separator of claim 22 wherein the first particle collector is positioned in the second particle separation member.

24. The separator of claim 23 wherein the second particle collector is removably mounted in a casing and the first particle collector is constructed to empty into the second particle when the second particle collector is removed from the casing.

25. The separator of claim 21 wherein the first particle collector is disposed adjacent the second particle separation member.

26. The separator of claim 17 wherein the particle transfer member comprises a pivotally mounted disc.

27. A separator for separating entrained particles from a fluid flow, the separator comprising: (a) first separating means for separating particles from the fluid flow; (b) second separating means for separating particles from the fluid flow; (c) first particle collecting means for collecting particles separated from the fluid flow by the first separating means; (d) second particle collecting means for collecting particles separated from the fluid flow by the second separating means; and, (e) directing means for directing particles from the first particle separating means to the first particle collecting means.

28. The separator of claim 27 wherein at least a portion of the directing means is angled downwardly whereby particles travel to the first particle collecting means at least partially under the influence of gravity.

29. The separator of claim28 wherein the second particle collecting means is positioned above the first

particle collecting means.

30. The separator of claim 29 wherein the first particle collecting means is removably mounted in a casing and the second particle collecting means empties into the first particle collecting means as the first particle collecting means is prepared for emptying.

31. The separator of claim 27 further comprising a cleaning head having a dirty air inlet and the separator is connectable in fluid flow communication with the dirty air inlet wherein the separator comprises the filtration stage of a vacuum cleaner.

32. A vacuum cleaner comprising a casing having at least two filtration stages whereby the filtration stages are configured so that dirt removed by each filtration is emptied at the same time.

33. The vacuum cleaner of claim 32 wherein the vacuum cleaner has a first filtration stage comprising a single cyclone and a second filtration stage comprsing a plurality of cyclones.

34. The vacuum cleaner of claim 33 wherein the plurality of second stage cyclones are connected in parallel.

35. The vacuum cleaner of claim 34 wherein the plurality of second stage cyclones are positioned upstream from the single cyclone.

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